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X.—*Observations on some of the Fossil Fishes of Dura Den.*

By Robert Walker*.

[Plate II.]

The following observations upon the Fossil Fishes of Dura Den are mainly based upon the examination of the large and valuable collection contained in the museum, for which we are much indebted to Mr. and Mrs. Dalgleish, on whose property they are found. I have endeavoured to make a careful examination of their external structure, with a view to determine some points regarding their generic and specific characters, which seemed to me to require further elucidation.

Before entering on this subject, it may be necessary to say a few words about some of the previous writings on this department of palæontology. The scales of *Holoptychius* were first described by the late Dr. Fleming, in 'Cheek's Edinburgh Journal,' 1831, as the scales of some "vertebrated animal, probably those of a fish;" they had been found, a year or two before, in the yellow sandstones of Drumdryan, about a mile to the west of Dura Den, by Dr. Fleming. A few years afterwards, entire specimens of *Holoptychius*, *Phaneropleuron*, *Pterichthys*, and some other fishes were found in the sandstones of Dura Den, and some of these were for the first time brought into notice by Dr. Anderson in his Geological Essay in 'Fife Illustrated.' It was not, however, till some of these fishes were submitted to the scrutiny of Agassiz that anything like correct generic and specific characters were assigned to them. These, with figures, were first published in the 'Poissons Fossiles du Vieux Grès Rouge,' the *Holoptychii* under the specific names of *Andersoni* and *Flemingii*.

* Communicated by the Author, having been read to the Literary and Philosophical Society, St. Andrews.

To the description of *H. Andersoni* perhaps little can now be added (what little may be hereafter added is more likely to affect its generic than its specific character). An additional description of this species has been given by Prof. Huxley in Dr. Anderson's 'Monograph of Dura Den,' and more recently in the 'Tenth Decade of the Geological Survey,' lately published, which contains a restoration of *Holoptychius*, and some descriptive remarks on that genus comprised in Prof. Huxley's excellent 'Preliminary Essay' on the Classification of the Devonian Fishes. The name *H. Flemingii* was founded by Agassiz on a piece of a fish which was found in Dura Den, I believe, by Dr. Fleming. It appears to have belonged to a fish of some size—fully larger than most fishes from that quarter. The same species, according to Agassiz, was afterwards found in the "Old Red of Russia."

Notwithstanding the distinct figure and clear description of the scales of this species given by Agassiz, it appears to have been overlooked by some geologists, and altogether disregarded as a distinct species by others. On the other hand, some palæontologists, while recognizing the distinct character of the scales of *H. Flemingii*, have asserted that they belonged to some part of *H. Andersoni*: among the latter was Prof. M'Coy, who was perhaps led into what seems to me to be an error in consequence of the fragmentary condition of his specimens; in his case, however, it appears the more remarkable, inasmuch as he had correctly observed and described the scales of *H. Flemingii* in his 'Palæozoic Fossils.' It would seem, however, that he had still doubts about the matter, as appears from the following sentence in the same work, in his description of *H. Sedgwickii*: "This species, like *H. Flemingii*, is remarkable for being found on its side, indicating apparently a compressed instead of a depressed form; it also resembles that species in the sculpturing of the scales." Nevertheless it appears to me that *H. Flemingii*, Agass., is not only a distinct species, but belongs also to another genus, viz. *Glyptolepis*. In general form *H. Flemingii* appears to have pretty closely resembled *H. Andersoni*; but in most specimens, if not in all, it was considerably deeper in proportion to the length. The pectoral and ventral fins appear to be strongly lobated; the latter, at any rate, in some specimens, were placed fully half their own length in front of the anterior dorsal, which was small, and placed far back. The caudal fin is not very distinctly exhibited in any specimen, but, so far as shown, it appears to be unequally lobed. The scales, as already described by Agassiz, are, when entire, a good deal higher than long, especially along the sides; on the dorsal and ventral areas they assume a rounder form. The ornamental lines on the exposed parts of the scales, on the sides, extend pretty horizontally

to the free edges, and seldom anastomose; but along the belly and towards the back, above the lateral line, where the sculpturing becomes bolder and sharply defined, anastomoses more frequently take place between the lines or ridges.

So far as yet stated, there is nothing to indicate more than specific differences; but when these scales are closely examined, a number of small and very distinct points or tubercles are seen, which form a semilunar or crescentic area on the posterior part of the first half of each scale, and immediately in front of the exposed sculpture. These tubercles appear as radiating in straight lines from a centre, which is not itself apparent, and are best seen on the scales that cover the sides of the fish. I have found them, however, more or less distinctly indicated, on well-preserved specimens, on nearly all parts of the body, from the ventral to almost the extreme dorsal edge. When the scales are entire, these crescentic areas are almost hidden by the overlapping of the anterior scales, and, excepting a very small part, they may be said to be altogether concealed. When the scales are not well preserved, of course these tubercles are obliterated altogether; but when well-preserved specimens are met with, and the overlapping scales are absent or removed, then these tubercles are very distinct and easily recognized (fig. 2); and

Fig. 1.

Fig. 2.

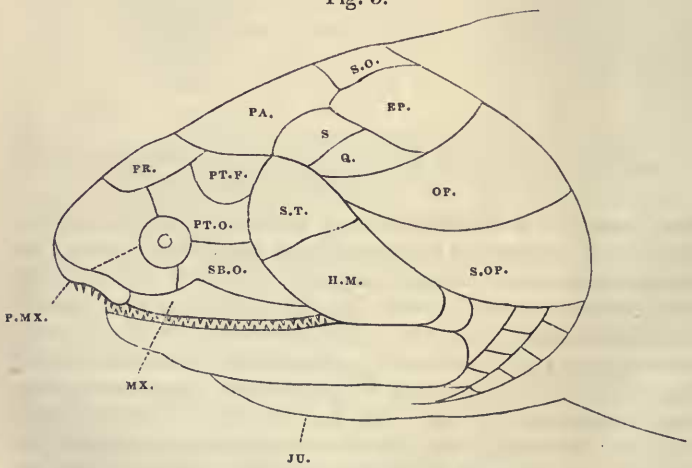
Fig. 1. Scale of *Glyptolepis*, from the side; natural size.
Fig. 2. Scale of *Holoptychius Flemingii*, from the ventral surface, about two inches behind the jugular plates; natural size.

when compared with specimens of undoubted *Glyptolepis* (for which I am indebted to the kindness of Mr. Powrie), and then with the figures and description of the scales of that genus in Prof. Huxley's essay, 'Decade X.,' the resemblance is at once apparent and unmistakeable. In some cases the resemblance is even closer to the figure from Pander, given in the above decade, than to that of the figures by Huxley, which were drawn (as he says) from a scale of *Glyptolepis* from Wick. To Prof. Pander is due the credit of having first discovered the true sculpture of the scales of *Glyptolepis*, which he wrought out of a Lethan-Bur nodule; while Prof. Huxley has still further elucidated and confirmed the matter, which he says he did by "scraping away the inner layers of the scales of undoubted examples of this genus

in the Museum of Practical Geology," &c. He further states, "The clear recognition of the fact that this elegant structure really characterizes *Glyptolepis* is of great importance, for it enables one to discriminate between *Holoptychius* (whose scales have no semilunar area of backwardly-directed points) and *Glyptolepis*." As we have just seen, the scales of *H. Flemingii*, Agass., have the identical structure of the scales of undoubted specimens of *Glyptolepis*, so far, at least, as the crescent of points is concerned, which seems to be the only tangible difference between them generically (*Holoptychius* and *Glyptolepis*). Such being the case, we are warranted in pronouncing *H. Flemingii* to be a true *Glyptolepis*.

The head of *H.* (*G.*) *Flemingii* is in length to that of the body as 1 to 4 or 5, and is of a depressed roundish form, gradually tapering towards the snout, which is blunt and round. The head is covered with granulated plates of no great thickness; on the sides of the head they join each other by squamous sutures, extending inward and upward. In this way these bones slightly overlap at the margins, without projecting externally. When their granulated surfaces happen to be uninjured, it is not always easy to determine where one bone ends and another begins. The occipital region is covered over by a median and two lateral bones; the median, or supra-occipital (s.o.), is truncated in front and rounded behind, where it partly overlaps the

Fig. 3.



Side view of the head of *H. Flemingii*.

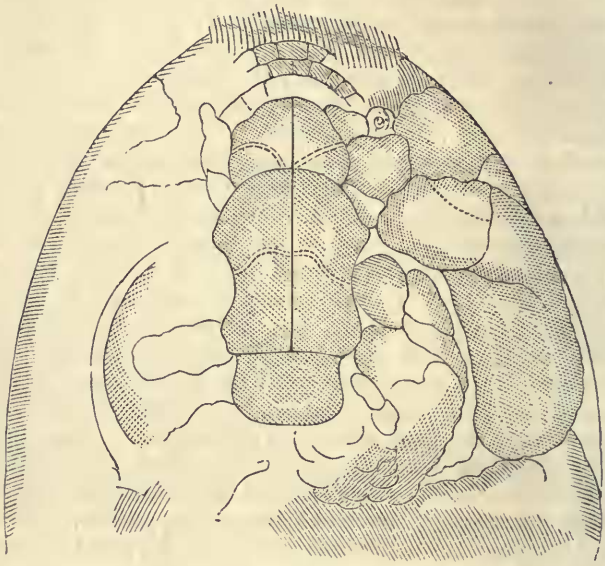
scales of the nape. The lateral or epiotic (EP.) extend backwards and downwards till they meet the operculum, their upper

anterior edges projecting forward a little beyond the commencement of the parietals. The parietals (PA.) are rather large bones, and, like the frontals, join each other on the middle of the cranium by a suture of square edges; their posterior ends are truncated where they meet the supra-occipital, the anterior somewhat regularly rounded, the round terminating on the antero-lateral edges in points, which are rendered more apparent by their lateral margins being concave. Into these concave margins the upper edge of one of two bones, which may represent the squamosal (SQ.), is attached; they meet the epiotic posteriorly, and fill in the spaces between the parietals and operculum. The operculum (OP.) and sub-operculum (S.OP.) are distinct bones, co-adapted, and look somewhat like a single rudely crescent-shaped plate, with the concave edge turned upward, rounded behind, and slightly so in front. The opercular and squamosal bones are succeeded in front by two bones, the upper of which may represent the supra-temporal (S.T.), and meets the lower margin of the parietal; the lower bone, which may be the hyo-mandibular (H.M.?), fills in the space between the supra-temporal and the maxilla. Both these bones have their exposed surfaces ornamented by radiating striæ; on the upper bone the striæ proceed from a raised horizontal centre, on the lower bone from a raised nearly vertical centre. The frontals (FR.) are about half the length of the parietals, and not much more than half their breadth; the posterior margins, by which they meet the parietals, are concave, the anterior somewhat convex. There is a small bone on each side of the head, probably the post-frontal (PT.F.), which fits in between the frontals and the supra-temporals. The next bone in front is perhaps the post-orbital (PT.O.), which forms the posterior boundary of the orbit; its margins unite with the frontal, post-frontal, and supra-temporal; the lower edges unite behind the middle of the orbit with the sub-orbital bone (SB.O.), which thus forms the lower boundary of the orbit behind and fills in the space between the post-orbital and the maxilla. The bones in front of the orbits are not distinctly defineable on any specimen that I have seen; but it appears as if the lower edge of the pre-frontal passed back between the orbit and the maxilla till it met the sub-orbital. Neither are the bones before the frontals clearly legible; the space seems to be occupied by a number of small four- and five-sided plates, which may represent the ethmoid, &c. The maxillæ (MX.) do not appear to have been very strong; externally they were ornamented like the bones of the head, and had a row of small (as far as I have seen) equal-sized teeth on their lower edges. There appears to me to be a pretty distinct pre-maxilla (P.MX.), which joins the maxilla under the anterior margin of the orbit, and

there is a row of small slightly hooked teeth extending round its lower border.

The lower jaws appear to be strong, and are somewhat powerful-looking bones: there are two distinct rows of plates on each side between the rami and the two central jugular plates; the

Fig. 4.



Crushed head of *H. Flemingii.*

outermost row is the largest; their exterior margins seem to have been overlapped a little by the inferior edge of the rami, while they in turn overlapped the margins of the next; these plates are longer than broad, and meet each other by oblique sutures passing inwards. The inner row of plates is about half the breadth of the outer, and they join together by more transverse sutures. These plates or bones are continued back, and turned up, on the sides of the head, behind the articulation of the inferior maxilla, till they terminate below the inferior margin of the sub-operculum.

So far as I can perceive, the cranium above described does not appear to differ in any respect from that of *H. Andersoni*: the head of the latter species is not, in general, so well preserved; but so far as the bones are exposed, they seem to me to be the same in number, arrangement, and shape. Neither does it differ materially from the bones of the head of *Glyptopomus*, as figured by Prof. Huxley; in fact, the resemblance in

this case is very close, which is not altogether what we might expect: we should rather have expected to find the head of that genus agreeing in this respect with *Glyptolæmus* and *Osteolepis*.

There are some other specimens of *Glyptolepis* from Dura Den in the museum, which now appear to me deserving of a more particular notice than I at first thought. These fishes have appeared to me for a considerable time to be only a variety of *H. Flemingii*; but a more careful examination of some of these specimens has now convinced me that they are specifically distinct: at least, the differences between these two forms are as great as that which exists between many of our present species. Upon comparing specimens of both forms, about the same size, I find the following differences:—The fishes in question have the head rather shorter in proportion to the whole length; the first dorsal and the ventral fins are placed an inch (in some cases more) nearer the head; the dorsal and anal fins are larger than the same fins in any specimen of *H. Flemingii* that I have ever seen; and the scales, which will be more particularly noticed hereafter, have their external sculpture much finer.

The specimen figured in Plate II. measures $10\frac{1}{2}$ inches in length; to this we may perhaps add another inch to complete the caudal extremity. The head is to the whole length as 1 to 5 or $5\frac{1}{2}$. The greatest depth of the body is halfway between the termination of the head and the commencement of the first dorsal fin, where it attains to 3 inches, from which it gradually tapers to the beginning of the caudal fin, where it is $1\frac{1}{2}$ inch deep. The pectoral fins are not preserved on any specimen. The first dorsal fin commences six inches behind the snout; its longest rays are $1\frac{1}{2}$ inch in length; the second dorsal fin is inserted about an inch behind the termination of the first: this appears to have been a large fin, with a round free margin; the longest rays measure $1\frac{3}{4}$ inch in length. The ventral fins are placed a little further forward than the first dorsal; but they are not in a sufficient state of preservation, on this or any other specimen, to show their exact form. The anal fin is situated under the second dorsal, and terminates in a somewhat pointed extremity; its longest rays are $1\frac{1}{2}$ inch in length. The tail appears to be heterocercal: the lower lobe is well developed, but rather abruptly truncated at its posterior margin; its first rays originate about $\frac{1}{4}$ inch behind the anal fin, where they are $1\frac{3}{4}$ inch in length; from this point they become gradually shorter as they near the distal end: the upper lobe consists of a number of short rays, which form a kind of marginal fringe on the upper side of the notochord. The scales are rounded, and appear to be rather thin; but they have the crescentic area of tubercles on their anterior half very clearly exhibited (fig. 2). The exposed surfaces

of the scales have fine thread-like sculptured lines extending from the tubercles to the free margin; these lines seldom anastomose.

Whether the preceding is a new species of *Glyptolepis*, or not, would at present be rather premature to say. However this may be, it has never been noticed before as occurring among the Dura-Den fishes.

There is another specimen in the museum which shows the *Glyptolepis* crescentic structure of scale on some parts; it appears to have been a fish of some size, perhaps 2 feet or more in length, and is altogether different from *H. Flemingii* or the fish last noticed. The specimen is laid nearly on the back; the head and a considerable portion of the anterior of the body are wanting. The scales on the ventral surface and one of the sides for about two or three inches above the lateral line are well exposed, although not in a very good state of preservation. The scales are about an inch, some of them rather more, in diameter, and their external sculpture is more like the scales of *H. giganteus*, Agass., than any other scales that I know: those on the belly do not show the crescentic area of points; whether the points have never been there, or have been destroyed in lifting the specimen, is not easy to determine; but, on the flank and above the lateral line, some of the scales exhibit the area of points in front of the exposed sculpture very distinctly. From what I recollect of the large fish found in Dura Den, last year, by Dr. Anderson, I think it not unlikely that it and the large specimen above noticed will yet be found to belong to the same species.

If I am not greatly mistaken, Dr. Anderson's specimen of last year has the same form of tail as the *Glyptolepis* figured by Miller in pl. 5 of the 'Old Red Sandstone.' The finding of the crescent of points on the large specimen has made me look still more closely to the scales of *H. Andersoni*; besides, it has often appeared to me very probable that to whatever genus *H. Flemingii* might be assigned, *H. Andersoni*, from its close resemblance, must also be assigned: in accordance with this view, I have carefully looked over every specimen and fragment in the museum (and, thanks to the labours of Dr. Heddle, they are not few); but as yet I have entirely failed in finding the characteristic crescent of points on the scales of any undoubted specimen of *H. Andersoni*. But the further consideration of this and some other matters connected with these Dura-Den fossil fishes must be left for another paper, wherein I will also direct attention to some specimens of fishes either new to Dura Den or at least not well known.